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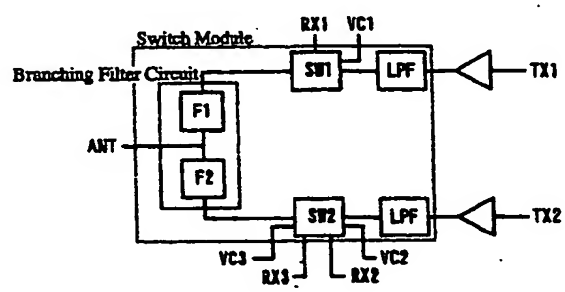
(54) **HIGH-FREQUENCY SWITCH MODULE**

(57) A high-frequency switch module for selectively connecting the transmitter or receiver circuit of a plurality of different transmitting and receiving systems comprises a first and second filter circuits with different pass bands; a first switch circuit connected with the first filter circuit for selectively connecting the transmitter or receiver circuit of the first transmitting and receiving system and a second switch circuit connected with the second filter circuit for selectively connecting the transmitter circuits of the second and third transmitting and receiving systems, the receiver circuit of the second transmitting and receiving system, or the receiver circuit of the third transmitting and receiving system. The transmitter circuit of the second transmitting and receiving system is identical to that of the third transmitting and receiving system. The high-frequency switch module can be designed compact while providing desired electrical characteristics. The second and third transmitting and receiving systems can share some components of their transmitter circuits, resulting in a smaller and more lightweight portable communication device using such a high-frequency switch module.

Fig. 1



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between the first output terminal and the ground; and a third diode connected between the input/output terminal and the second output terminal.

[0009] Each of the first and second distributed constant lines preferably has a line length in which a resonance frequency thereof is within a range between the maximum frequency and the minimum frequency in a frequency band of the reception signal for the second and third transmitting and receiving systems, particularly a middle frequency of the maximum and minimum frequencies.

[0010] In another preferred embodiment, the second switch circuit comprises an input/output terminal for inputting a reception signal for the second and third transmitting and receiving systems from the second filter circuit and outputting a transmission signal from the transmission circuit of the second and third transmitting and receiving systems; an input terminal for inputting a transmission signal from the transmission circuit of the second and third transmitting and receiving systems; a third output terminal for outputting a reception signal of the second and third transmission systems; and a fourth output terminal for outputting a reception signal of the second transmitting and receiving system to the reception circuit; a fifth output terminal for outputting a reception signal of the third transmitting and receiving system to the reception circuit; a first diode connected between the input/output terminal and the input terminal; a first distributed constant line connected between the input terminal and a ground; a second distributed constant line connected between the input/output terminal and the third output terminal; a second diode connected between the third output terminal and the ground; a third distributed constant line connected between the third output terminal and the fourth output terminal; a third diode connected between the fourth output terminal and the ground; a fourth diode connected between the third output terminal and the fifth output terminal; and a fourth distributed constant line connected between the fifth output terminal and the ground.

[0011] The first distributed constant line preferably has a line length in which a resonance frequency thereof is within a range between the maximum frequency and the minimum frequency in a frequency band of the transmission signal for the second and third transmitting and receiving systems. The second distributed constant line preferably has a line length in which a resonance frequency thereof is within a range between the maximum frequency and the minimum frequency in a frequency band of the transmission signal for the second and third transmitting and receiving systems. The third distributed constant line preferably has a line length in which a resonance frequency thereof is within a range between the maximum frequency and the minimum frequency in a frequency band of the reception signal for the third transmitting and receiving system. The fourth distributed constant line preferably has a line length in which a resonance frequency thereof is within a range between the maximum frequency and the minimum frequency in a frequency band of the reception signal for the third transmitting and receiving system.

[0012] In the present invention, a low-pass filter circuit comprising a distributed constant line and a capacitor is preferably connected between the second filter circuit and the transmission circuit for the second and third transmitting and receiving systems. The line length of the distributed constant line constituting the low-pass filter circuit is preferably $\lambda/8$ to $\lambda/12$, wherein λ is a middle frequency of the transmission signal for the second and third transmitting and receiving systems.

[0013] Each of the first and second filter circuits preferably comprises a distributed constant line and a capacitor. At least part of the distributed constant lines and the capacitors in the first and second filter circuits and the distributed constant lines in the first and second switch circuits is preferably constituted by electrode patterns in a laminate comprising dielectric layers having electrode patterns. The diodes in the first and second switch circuits are preferably disposed on the laminate.

[0014] A low-pass filter circuit comprising a distributed constant line and a capacitor is preferably connected between the second filter circuit and the transmission circuit for the second and third transmitting and receiving systems. The line length of the distributed constant line constituting the low-pass filter is preferably $\lambda/8$ to $\lambda/12$, wherein λ is a middle frequency of the transmission signal for the second and third transmitting and receiving systems, and at least part of the distributed constant lines and the capacitors are constituted by electrode patterns in the laminate.

[0015] The distributed constant line in the switch circuit is preferably formed by electrode patterns formed in a region sandwiched by a pair of ground electrodes. Capacitors in the first and second filter circuits are preferably formed on a pair of ground electrodes, and distributed constant lines in the first and second filter circuits are preferably formed thereon.

[0016] The distributed constant line in the switch circuit is preferably formed by electrode patterns formed in a region sandwiched by a pair of ground electrodes. Capacitors in the low-pass filter circuit and capacitors in the first and second filter circuits are preferably formed on a ground electrode, and a distributed constant line in the low-pass filter circuit and distributed constant lines in the first and second filter circuits are preferably formed thereon. The first and second filter circuits and the low-pass filter circuit are preferably formed in separate regions not overlapping in a laminating direction of the laminate.

BRIEF DESCRIPTION OF THE DRAWINGS

[0017]

Fig. 1 is a block diagram showing a circuit of a high-frequency switch module according to one embodi-

frequency: 925-960 MHz), the second transmitting and receiving system is DCS1800 (transmission frequency: 1710-1785 MHz, reception frequency: 1805-1880 MHz), and the third transmitting and receiving system is PCS (transmission frequency: 1850-1910 MHz, reception frequency: 1930-1990 MHz).

(A) First and second filter circuits

[0020] Each of the first and second filter circuits F1, F2 connected to an antenna ANT is constituted by a distributed constant line and a capacitor. The equivalent circuit shown in Fig. 2 comprises a low-pass filter as a first filter circuit F1 for passing transmission and reception signals of GSM while attenuating transmission and reception signals of DCS1800 and PCS, and a bypass filter as a second filter circuit F2 for passing the transmission and reception signals of DCS1800 and PCS while attenuating the transmission and reception signals of GSM.

[0021] The low-pass filter F1 comprises a distributed constant line LF1, a capacitor CF1 connected in parallel to LF1, and a capacitor CF3 connected between LF1 and CF1 and a ground. The bypass filter F2 comprises a distributed constant line LF2, a capacitor CF2 connected in parallel to LF2, a distributed constant line LF3 connected between LF2 and CF2 and a ground, and a capacitor CF4 connected in series to the distributed constant line LF2 and the capacitor CF2. Incidentally, the first and second filter circuits F1, F2 are not restricted to such a structure, permitting the following structures (a) - (h):

(a) A structure comprising a low-pass filter as a first filter circuit F1, and a notch filter as a second filter circuit F2;
(b) A structure comprising a notch filter as a first filter circuit F1, and a band-pass filter as a second filter circuit F2;
(c) A structure comprising a low-pass filter as a first filter circuit F1, and a band-pass filter as a second filter circuit F2;
(d) A structure comprising a notch filter as a first filter circuit F1, and a notch filter as a second filter circuit F2;
(e) A structure comprising a notch filter as a first filter circuit F1, and a high-pass filter as a second filter circuit F2;
(f) A structure comprising a band-pass filter as a first filter circuit F1, and a band-pass filter as a second filter circuit F2;
(g) A structure comprising a band-pass filter as a first filter circuit F1, and a notch filter as a second filter circuit F2; and
(h) A structure comprising a band-pass filter as a first filter circuit F1, and a high-pass filter as a second filter circuit F2.

(B) Switching circuits

[0022] A diode and a distributed constant line are main elements in each of the first switch circuit SW1 disposed downstream of the first and second filter circuits F1, F2 for switching the transmission circuit TX1 and the reception circuit RX1 both for GSM, and the second switch circuit SW2 disposed downstream of the first and second filter circuits F1, F2 for switching the transmission circuit TX2 for DCS1800 and PCS, the reception circuit RX2 for DCS1800, and the reception circuit RX3 for PCS.

[0023] The first switch circuit SW1 is a switch circuit positioning on an upper side in Fig. 2, for switching the transmission circuit TX1 and the reception circuit RX1 for GSM. The first switch circuit SW1 comprises two diodes DG1, DG2 and two distributed constant lines LG1, LG2 as main elements. The diode DG1 is connected between an input/output terminal IP1, to which an anode of the diode DG1 is connected, and the transmission circuit TX1, and the distributed constant line LG1 is connected to a cathode of the diode DG1 and a ground electrode. The distributed constant line LG2 is connected between the input/output terminal IP1 and the reception circuit RX1, and the diode DG2 is connected between one end of the distributed constant line LG2 on the side of the reception circuit RX1 and a ground electrode. Further, the capacitor CG6 is connected between an anode of the diode DG2 and a ground electrode. Connected in series between the above anode and the control circuit VC1 are an inductor LG and a resister R1.

[0024] Each of the distributed constant lines LG1 and LG2 has a line length in which their resonance frequencies are within a frequency band of the transmission signal of GSM. For instance, when their resonance frequencies are substantially equal to a middle frequency (897.5 MHz) of the transmission signal frequency of GSM, excellent insertion loss characteristics can be obtained within the desired frequency band. The low-pass filter circuit LPF inserted between the first filter circuit F1 and the transmission circuit TX1 preferably comprises a distributed constant line and capacitor. In the equivalent circuit shown in Fig. 2, a π-type low-pass filter constituted by a distributed constant line LG3 and capacitors CG3, CG4 and CG7 is preferably inserted between the diode DG1 and the distributed constant line LG1.

[0025] The second switch circuit SW2 is a switch circuit positioning on a lower side in Fig. 2, for switching the transmission circuit RX2 for DCS1800, the reception circuit RX3 for PCS and the transmission circuit TX2 for DCS1800 and PCS. The second switch circuit SW2 comprises three diodes DP1, DP2 and DP3 and two distributed constant lines LP1, LP2 as main elements. The diode DP1 is connected between an input/output terminal IP2, to which a cathode of the diode DP1 is connected, and the transmission circuit TX2. The

DP1, DP2 and DP3 in an OFF state. With the diode DP2 in an OFF state, the connecting point IP2 is connected to the second reception circuit RX2 via the distributed constant line LP2. Also, with the diode DP1 in an OFF state, there is large impedance between the connecting point IP2 and the transmission circuit TX2 of the second and third transmitting and receiving systems. Further, with the diode DP3 in an OFF state, there is large impedance between the connecting point IP2 and the third reception circuit RX3. As a result, the reception signal from the second filter circuit F2 is transmitted to the second reception circuit RX2, without leaking to the transmission circuit TX2 of the second and third transmitting and receiving systems and the third reception circuit RX3.

(C) PCS RX mode

[0035] To connect the third reception circuit RX3 to the second filter circuit F2, positive voltage is applied from the control circuit VC2, and zero voltage is applied from the VC3. Positive voltage applied from the control circuit VC2 is deprived of a DC component by the capacitors CP5, CP6, CP8 and CF4, and applied to a circuit comprising the DP1, DP2 and DP3. As a result, the diodes DP2 and DP3 are turned on, while the diode DP1 is turned off. With the diode DP3 in an ON state, there is small impedance between the third reception circuit RX3 and the connecting point IP2. Also, with the diode DP2 in an ON state and the capacitor CP6, the distributed constant line LP2 is grounded in a high-frequency manner, resulting in resonance in a frequency band of the transmission signal for DCS1800 and PCS. Thus, impedance when the second reception circuit RX2 is viewed from the connecting point IP2 is extremely large in a frequency band of the reception signal for PCS. Further, with the diode DP1 in an OFF state, there is large impedance between the connecting point IP2 and the transmission circuit TX2 of the second and third transmitting and receiving systems. As a result, the reception signal from the second filter circuit F2 is transmitted to the third reception circuit RX3 without leaking to the transmission circuit TX2 of the second and third transmitting and receiving systems and the second reception circuit RX2.

(D) GSM TX mode

[0036] To connect the first transmission circuit GSM TX to the first filter circuit F1, positive voltage is applied from the control circuit VC1. The positive voltage is deprived of a DC component by the capacitors CG6, CG5, CG4, CG3, CG2 and CG1, and applied to a circuit comprising the diodes DG2 and DG1. As a result, the diodes DG2 and DG1 are turned on. With the diode DG1 in an ON state, there is low impedance between the first transmission circuit TX1 and the connecting point IP1. With the diode DG2 in an ON state and the capacitor CG6, the distributed constant line LG2 is grounded in a high-frequency manner, resulting in resonance. Thus, impedance is extremely large when the first reception circuit RX1 is viewed from the connecting point IP1. As a result, the transmission signal from the first transmission circuit TX1 is transmitted to the first filter circuit F1 without leaking to the reception circuit RX1.

(E) GSM RX mode

[0037] To connect the first reception circuit GSM RX to the first filter circuit F1, zero voltage is applied from the control circuit VC1 to turn off the diodes DG1 and DG2. With the diode DG2 in an OFF state, the connecting point IP1 is connected to the second reception circuit RX1 via the distributed constant line LG2. Also, with the diode DG1 in an OFF state, there is large impedance between the connecting point IP1 and the first transmission circuit TX1. As a result, the reception signal from the first filter circuit F1 is transmitted to the first reception circuit RX1 without leaking to the first transmission circuit TX1.

[0038] The present invention will be explained in further detail by the following EXAMPLES without intention of restricting the scope of the present invention thereto.

EXAMPLE 1

[0039] Fig. 3 is a plan view showing the high-frequency switch module in this EXAMPLE, Fig. 4 is a perspective view showing a laminate portion thereof, and Fig. 5 is a development view showing the structure of each layer constituting the laminate of Fig. 4. In EXAMPLE 1, the distributed constant lines of the first and second filter circuits, the low-pass filter circuit and the switch circuits are formed in the laminate, while diodes and high-capacitance capacitors as chip capacitors, which cannot be formed in the laminate, are mounted onto the laminate, resulting in a one-chip, triple-band, high-frequency switch module. Incidentally, symbols P1 to P16 attached to external terminals in Fig. 4 correspond to symbols such as P2, P4, etc. attached to the equivalent circuit of Fig. 2.

[0040] This laminate can be produced by (a) preparing green sheets of 50-200 μm in thickness from low-temperature-sinterable dielectric ceramics; (b) printing an electrically conductive, Ag-based paste onto each green sheet to form a desired electrode pattern; (c) integrally laminating a plurality of green sheets having desired electrode patterns; and (d) burning the resultant laminate. Line electrodes are preferably as wide as 100-400 μm.

[0041] The internal structure of the laminate will be explained in the order of lamination. First, a green sheet 11 for the lowermost layer is coated with a ground electrode 31 in substantially all surface and provided with

are respectively sandwiched by ground terminals.

[0055] Table 1 shows the control logic of each control circuit VC1, VC2 and VC3 for switching each mode of GSM, DCS1800 and PCS in the high-frequency switch module in this EXAMPLE.

Table 1

Mode	VC1	VC2	VC3
GSM TX	High	Low	Low
DCS TX	Low	Low	High
PCS TX	Low	Low	High
GSM RX	Low	Low	Low
DCS RX	Low	Low	Low
PCS RX	Low	High	Low

[0056] Figs. 11-15 show the characteristics of insertion loss and isolation at the time of transmission and reception in each communication mode. As shown in Figs. 11-15, excellent insertion loss characteristics and isolation characteristics were obtained in a desired frequency band in each communication mode, verifying that this EXAMPLE provided a miniaturized, high-performance, high-frequency switch module.

EXAMPLE 2

[0057] Fig. 6 shows an equivalent circuit of a high-frequency switch module according to another embodiment of the present invention; Fig. 7 is a plan view showing the high-frequency switch module; and Fig. 8 shows the internal structure of a laminate for the high-frequency switch module. Because there are many parts common in this EXAMPLE and EXAMPLE 1, explanation will be restricted here to only different parts.

[0058] The first and second filter circuits are the same as those in EXAMPLE 1. A first switch circuit SW1 in the first transmitting and receiving system (GSM) is also the same as in EXAMPLE 1, except that a distributed constant line LG1 is connected to a control circuit VC3 together with a distributed constant line LP1 of the second switch circuit SW2 without being connected to a ground electrode. In the second switch circuit, the directions of diodes DP1, DP2 and DP3 are opposite to those in EXAMPLE 1, and a control circuit VC4 is connected via a series-connected circuit of an inductor LD and a resister R3 between the diode DP2 and the capacitor CP6.

[0059] With respect to the structure of the high-frequency switch module, it differs from that of EXAMPLE 1 in the following points. A ground electrode 31 on a green sheet 11 is not connected to a terminal electrode 89. In a green sheet 15, a lead terminal of a line electrode 46 is modified. In a green sheet 17, a ground electrode 32 is not connected to a terminal electrode 89. In a green sheet 21, a line electrode 71, wiring line, is added. In a green sheet 22, a through-hole for connecting to the line electrode 71 is added. Also, in a green sheet 23, the shape of a land is modified.

[0060] Mounted onto the laminate are diodes DG1, DG2, DP1, DP2 and DP3 and chip capacitors CG1, CG6, CGP and CP6. Fig. 7 shows a laminate mounted with these elements. Fig. 7 also shows the mounting structure (connecting structure of each terminal) of the high-frequency switch module. In this EXAMPLE, CP2, CP5, CG2, CG5, R1, LG, R2, CP8, R3 and LD among elements constituting the equivalent circuit of Fig. 6 are mounted onto a chip-part-mounting circuit.

[0061] Table 2 shows the control logic of each control circuit VC1, VC2 and VC3 for switching each mode in the high-frequency switch module in this EXAMPLE.

Table 2

Mode	VC1	VC2	VC3	VC4
GSM TX	High	Low	Low	Low
DCS TX	Low	High	Low	High
PCS TX	Low	High	Low	High
GSM RX	Low	Low	Low	Low
DCS RX	Low	Low	Low	Low
PCS RX	Low	Low	High	High

[0062] The high-frequency switch module of this EXAMPLE can be used in three different communication modes, exhibiting the same effects as in EXAMPLE 1.

EXAMPLE 3

[0063] Fig. 9 shows an equivalent circuit of a high-frequency switch module according to another embodiment of the present invention. Because there are many parts common in this EXAMPLE and EXAMPLE 1, explanation will be restricted here to only different parts.

[0064] First and second filter circuits and a first switch circuit SW1 in the first transmitting and receiving system (GSM) are the same as in EXAMPLE 1 with respect to an equivalent circuit. A second switch circuit SW2 comprises an input/output terminal IP2 for inputting a reception signal for the second and third transmitting and receiving systems from the second filter circuit F2 and outputting a transmission signal from the transmission circuit TX2 of the second and third transmitting and receiving systems; an input terminal for inputting a transmission signal from the transmission circuit TX2 of the second and third transmitting and receiving systems; a third output terminal IP3 for outputting a reception signal of the second and third transmitting and

[0072] Though the high-frequency switch module of the present invention has been explained in detail referring to Figs. 1-10, it is not restricted thereto, and various modifications may be made unless deviating from the scope of the present invention. With respect to communication modes usable in the high-frequency switch module of the present invention, they are not restricted to combinations shown in EXAMPLES, but switching can be carried out among three different transmitting and receiving systems, for instance, a combination of GPS (Global Positioning System), D-AMPS (Digital Advanced Mobile Service) and PCS, or a combination of GSM, WCDMA (Wide-Band Code Division Multiple Access) and PCS.

APPLICABILITY IN INDUSTRY

[0073] Because the high-frequency switch module of the present invention can be used, for instance, for portable communications equipment such as triple-band cellular phones of a multi-communication system usable in three different communication modes, it can switch an antenna ANT, a transmission circuit TX1 and a reception circuit RX1 of the first transmitting and receiving system, a transmission circuit TX2 of the second and third transmitting and receiving systems, a reception circuit RX2 of the second transmitting and receiving system, and a reception circuit RX3 of the third transmitting and receiving system, with the transmission circuit of the second transmitting and receiving system and the transmission circuit of the third transmitting and receiving system being made common parts. Therefore, the high-frequency switch module of the present invention can be miniaturized while keeping excellent electric characteristics, with some parts such as amplifiers shared by the second and third transmitting and receiving systems. As a result, a portable communications equipment comprising the high-frequency switch module can be further miniaturized and reduced in weight.

Claims

1. A high-frequency switch module for switching a transmission circuit and a reception circuit in a plurality of different transmitting and receiving systems, comprising first and second filter circuits having different pass bands; a first switch circuit connected to said first filter circuit for switching a transmission circuit and a reception circuit in a first transmitting and receiving system; and a second switch circuit connected to said second filter circuit for switching a transmission circuit of second and third transmitting and receiving systems, a reception circuit of said second transmitting and receiving system and a reception circuit of said third transmitting and receiving system.

2. The high-frequency switch module according to claim 1, wherein said first and second filter circuits function as branching filter circuits for dividing a reception signal for said first transmitting and receiving system and a reception signal for said second and third transmitting and receiving systems.

3. The high-frequency switch module according to claim 1 or 2, wherein each of said first and second switch circuits is a diode switch comprising a diode and a distributed constant line as main elements, whereby one of said first, second and third transmitting and receiving systems is selected by controlling the on/off of said diode switches by applying voltage from a power supply means to said diode switches.

4. The high-frequency switch module according to claim 3, wherein said second switch circuit comprises an input/output terminal for inputting a reception signal for said second and third transmitting and receiving systems from said second filter circuit and outputting a transmission signal from said transmission circuit of said second and third transmitting and receiving systems; an input terminal for inputting a transmission signal from said transmission circuit of said second and third transmitting and receiving systems; a first output terminal for outputting a reception signal of said second transmitting and receiving system to said reception circuit; and a second output terminal for outputting a reception signal of said third transmitting and receiving system to said reception circuit; a first diode connected between said input/output terminal and said input terminal; a first distributed constant line connected between said input terminal and a ground; a second distributed constant line connected between said input/output terminal and said first output terminal; a second diode connected between said first output terminal and said ground; and a third diode connected between said input/output terminal and said second output terminal.

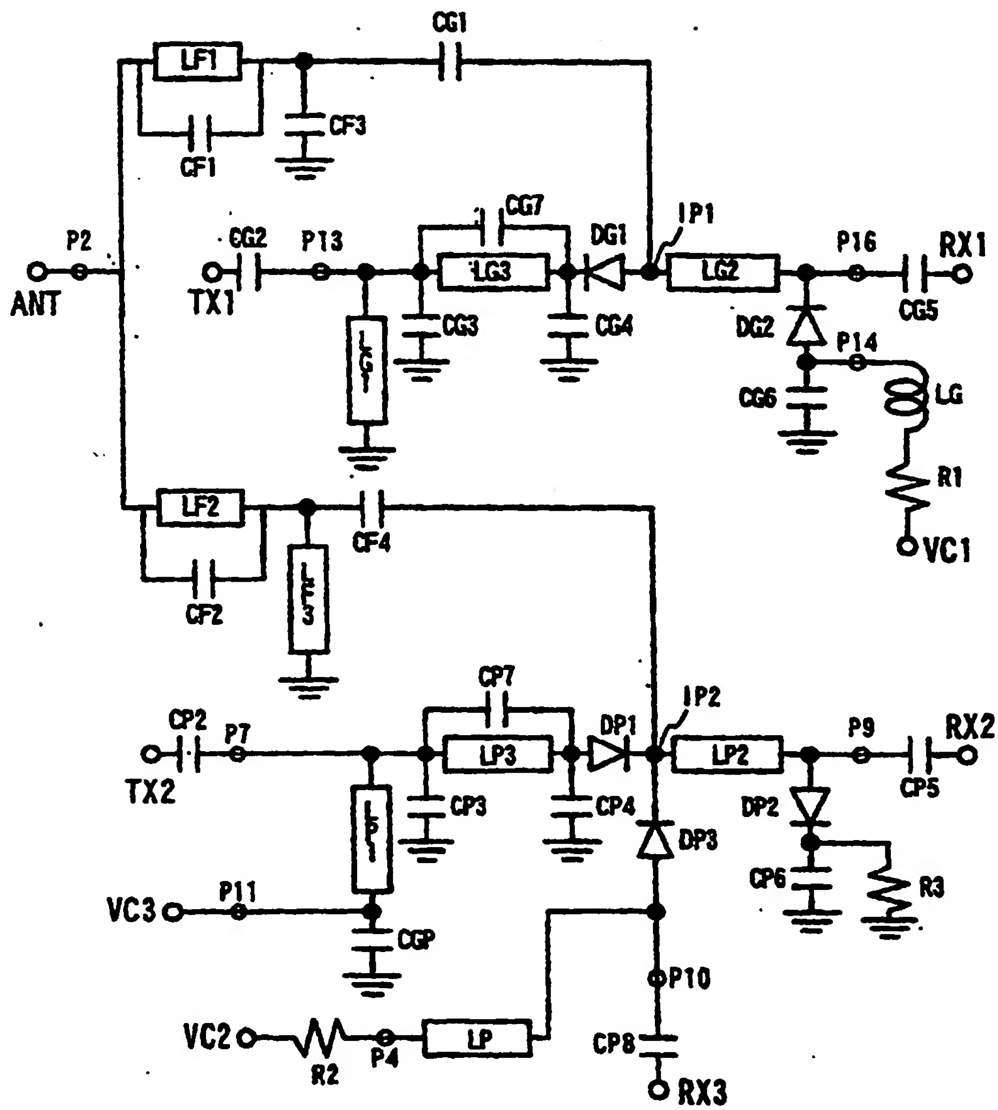
5. The high-frequency switch module according to claim 4, wherein each of said first and second distributed constant lines has a line length in which a resonance frequency thereof is within a range between the maximum frequency and the minimum frequency in a frequency band of said reception signal for said second and third transmitting and receiving systems.

6. The high-frequency switch module according to claim 3, wherein said second switch circuit comprises an input/output terminal for inputting a reception signal for said second and third transmitting

said first and second filter circuits are formed thereon.

16. The high-frequency switch module according to claim 15, wherein said first and second filter circuits and said low-pass filter circuit are formed in separate regions not overlapping in a laminating direction of said laminate.

Fig. 2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CF3
CF1
CG7
P2
CG2
P13
DG1
IP1
P16
RX1
ANT
TX1
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LG2
CG3
CG4
CG5
DG2
P14
LG1
CG6
LG
R1
LF2
CF4
VC1
CF2
LF3
CP7
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CP2
P7
DP1
P9
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TX2
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CP3
CP4
CP5
DP2
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P10
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CP8
R2
P4
RX3

Fig. 5

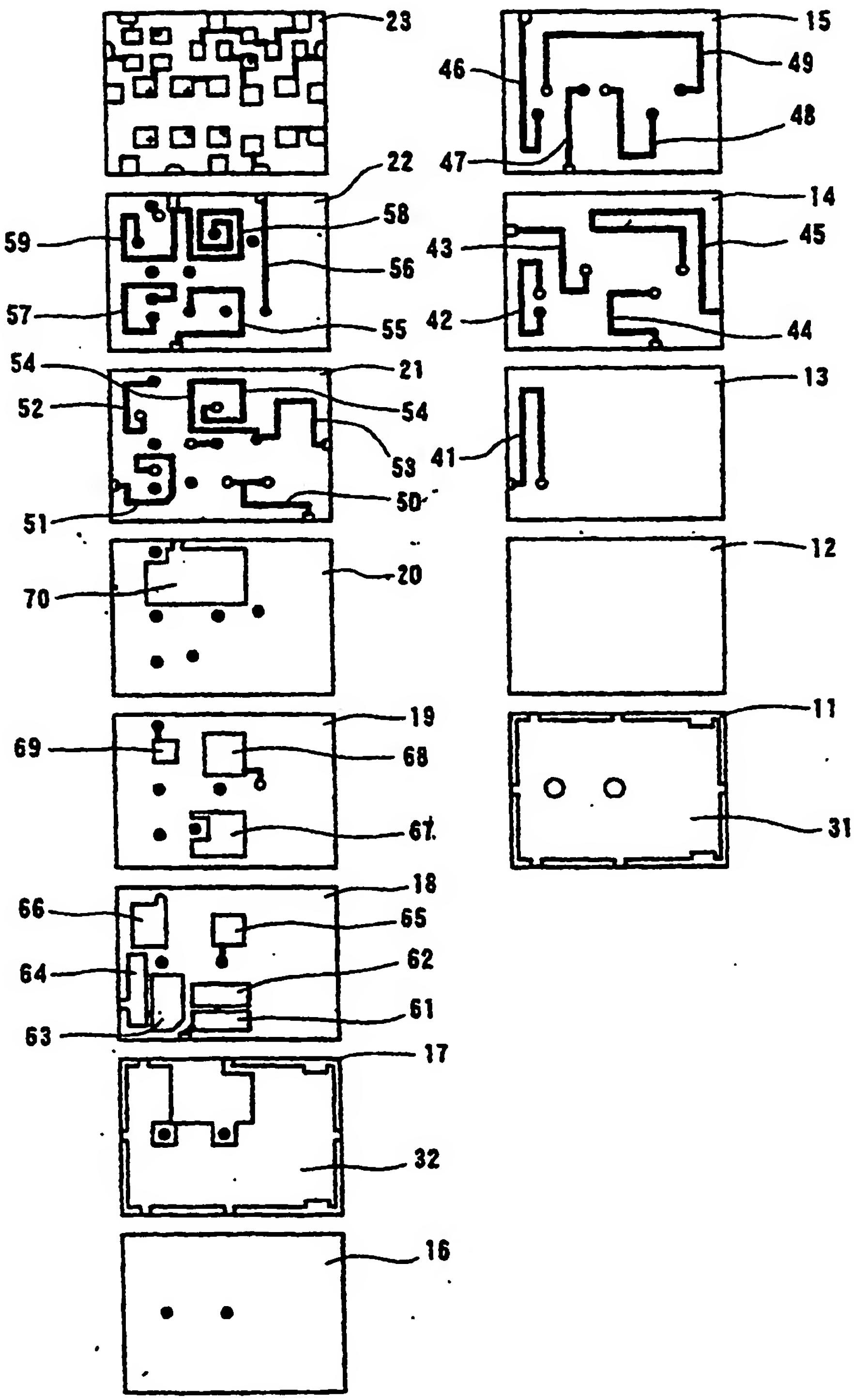
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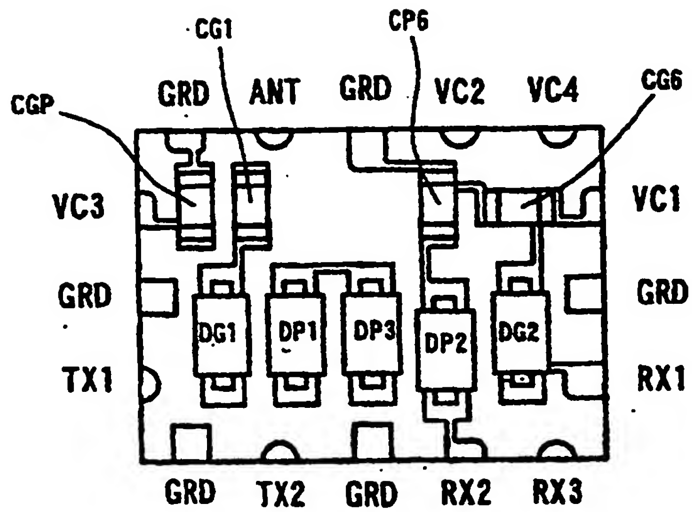
Fig. 7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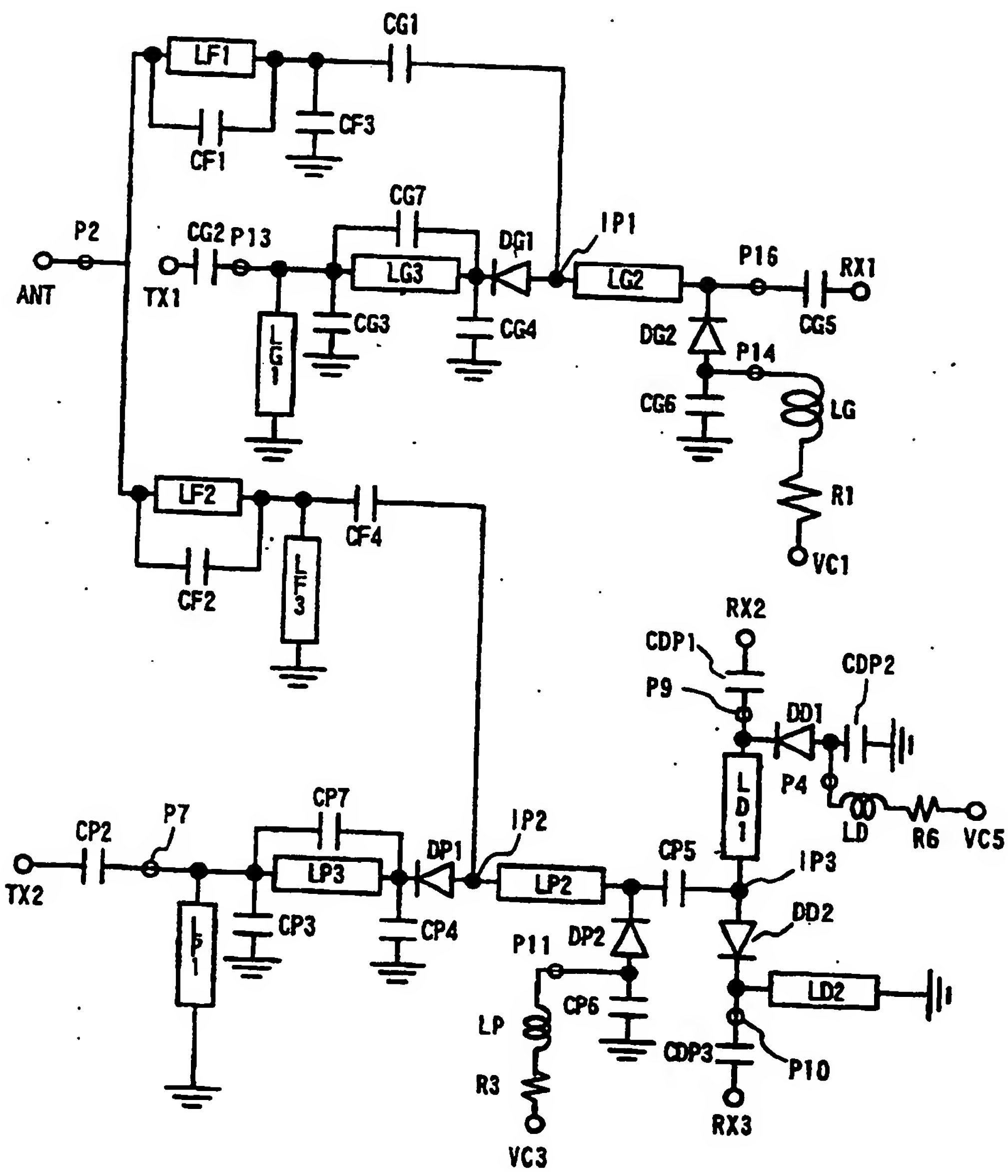
GRD
RX2
RX3

Fig. 9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DG2
P14
CG6
LG
LF2
R1
CF4
VC1
CF2
LF3
RX2
CDP1
CDP2
P9
DD1
P4
LD1
CP7
LD
R6
VC5
P7
IP2
CP2
DP1
CP5
IP3
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LP3
LP2
CP3
CP4
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CP6
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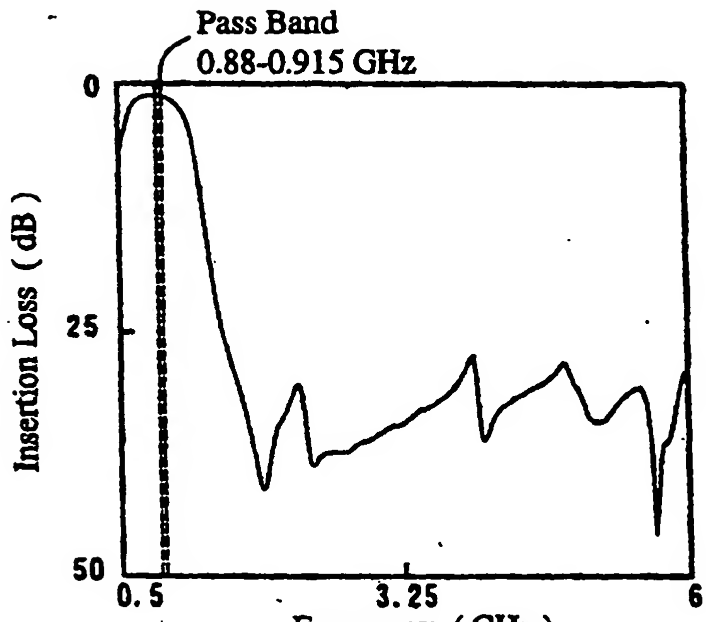
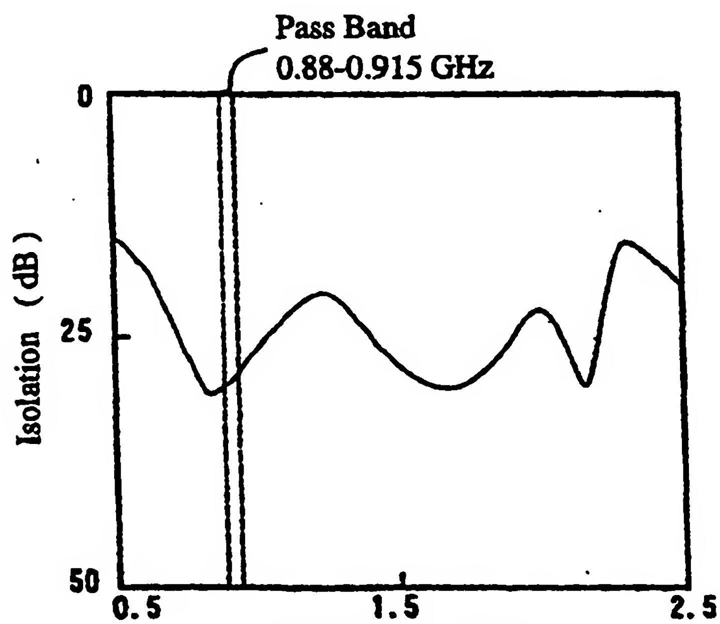
P10
R3
RX3
VC3

Fig. 11(a)



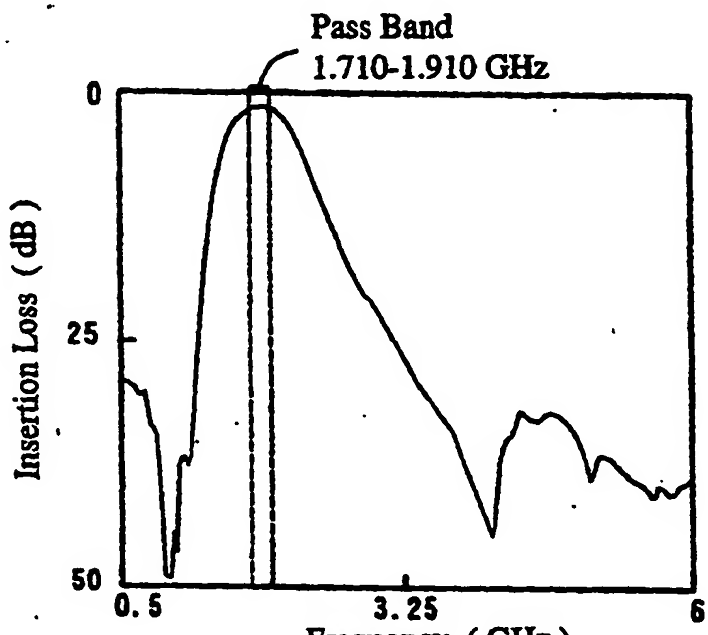
Insertion Loss Characteristics Between TX and ANT

Fig. 11(b)



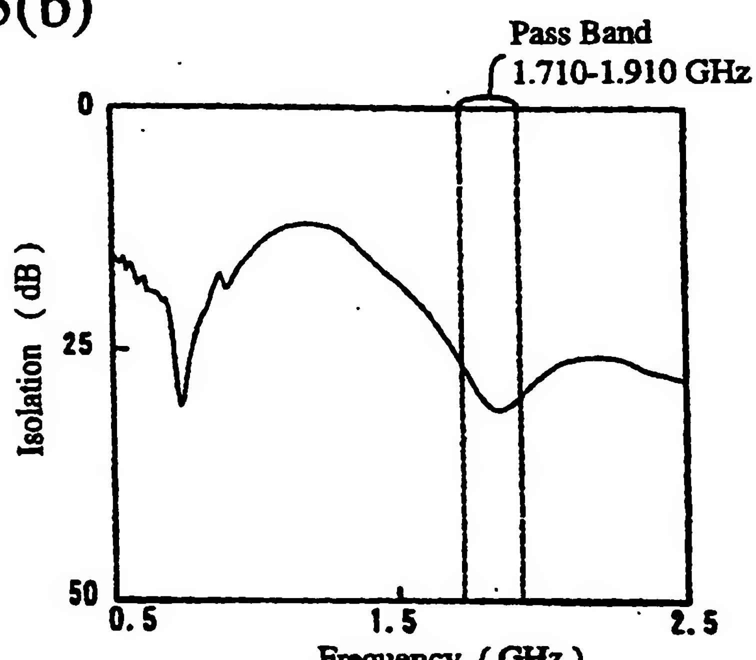
Isolation Characteristics Between TX1 and RX1

Fig. 13(a)



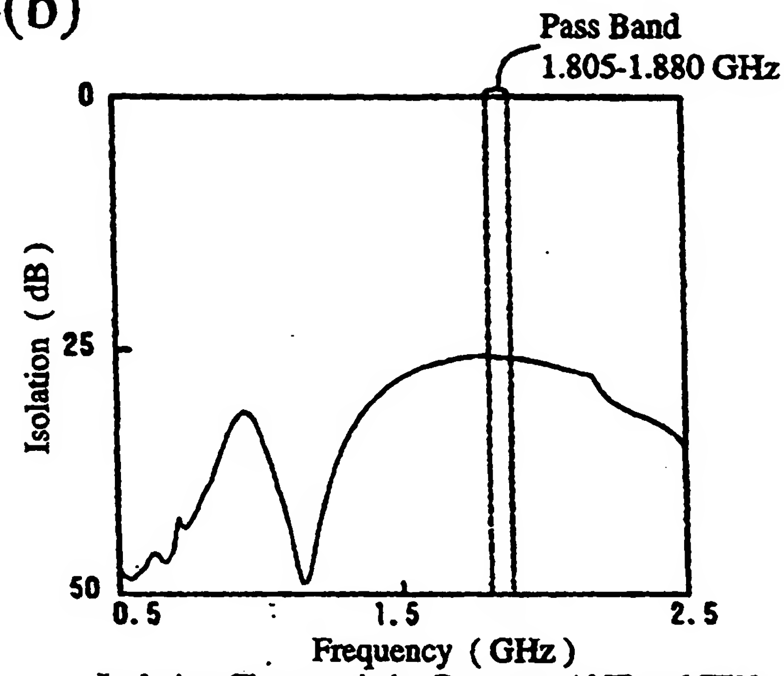
Insertion Loss Characteristics Between TX2 and ANT

Fig. 13(b)



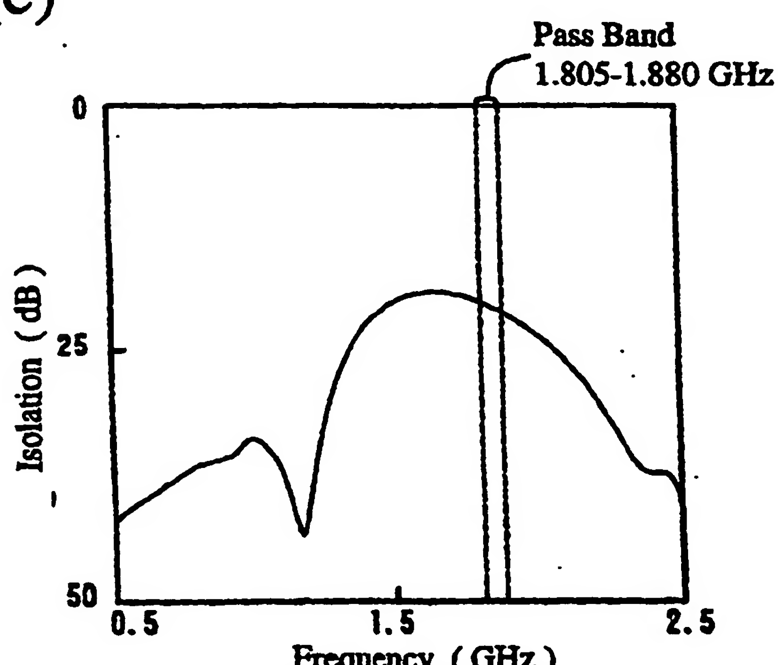
Isolation Characteristics Between TX2 and RX2

Fig. 14(b)



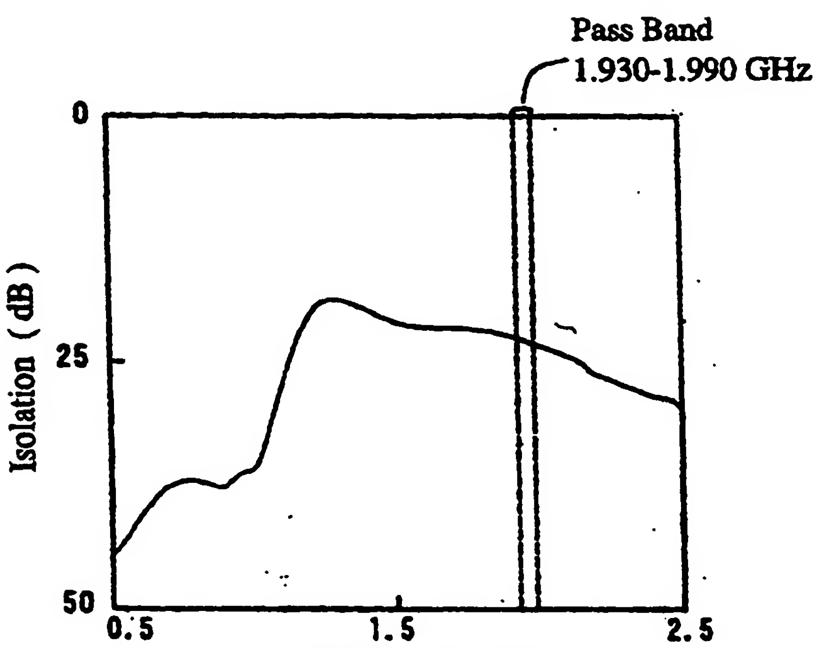
Isolation Characteristics Between ANT and TX2

Fig. 14(c)



Isolation Characteristics Between ANT and RX3

Fig. 15(c)



Isolation Characteristics Between ANT and RX2

INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP00/01670

A. CLASSIFICATION OF SUBJECT MATTER
Int.Cl^7 H04B 1/44
H01P 1/15

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
Int.Cl^7 H04B 1/38-1/58
H01P 1/15

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Jitsuyo Shinan Koho	1922-1996	Toroku Jitsuyo Shinan Koho	1994-2000
Kokai Jitsuyo Shinan Koho	1971-2000	Jitsuyo Shinan Toroku Koho	1996-2000

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
	JP, 2000-165274, A (Murata MFG. Co., Ltd.), 16 June, 2000 (16.06.00),	
EX	Full text; Figs. 1 to 5	1-3,8-10
EY	Full text; 第・-5図	4,5,11-16
	(Family: none)	
	JP, 2000-165288, A (Murata MFG. Co., Ltd.), 16 June, 2000 (16.06.00),	
EX	Full text; Figs. 1-5	1-3,8-10
EY	Full text; Figs. I-5	6,7,11-16
	(Family: none)	
A	JP, 10-135702, A (Hitachi Metals, Ltd.), 22 May, 1998 (22.05.98), Full text; Figs. 1 to 7 (Family: none)	11-16

☐ Further documents are listed in the continuation of Box C. ☐ See patent family annex.

* Special categories of cited documents:
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"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
12 June, 2000 (12.06.00)	27 June, 2000 (27.06.00)
Name and mailing address of the ISA/ Japanese Patent Office	Authorized officer
Facsimile No.	Telephone No.

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